NASA TECHNICAL MEMORANDUM

NASA TM X-71870

NASA TM X-71870

STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - A SELECTIVELY COATED, STEEL COLLECTOR WITH ONE TRANSPARENT COVER

by Power Systems Division
Lewis Research Center
Cleveland, Ohio 44135
January 1976

(NASA-TM-X-71870) STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: A SELECTIVELY COATED, STEEL COLLECTOR WITH ONE TRANSPARENT COVER (NASA) 7 p HC $3.50 CSCL 10A G3/44

N76-17643

Unclas
14160

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM X-71870		

4. Title and Subtitle	5. Report Date
STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - A SELECTIVELY COATED, STEEL COLLECTOR WITH ONE TRANSPARENT COVER	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Power Systems Division	10. Work Unit No.
9. Performing Organization Name and Address	
Lewis Research Center National Aeronautics and Space Administration Cleveland, Ohio 44135	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered Technical Memorandum
National Aeronautics and Space Administration Washington, D.C. 20546	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This preliminary data report gives basic test results of a flat-plate solar collector whose performance was determined in the NASA-Lewis solar simulator. The collector was tested over ranges of inlet temperatures, fluxes and coolant flow rates. Collector efficiency is correlated in terms of inlet temperature and flux level.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
	Unclassified - unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified		

* For sale by the National Technical Information Service, Springfield, Virginia 22161

STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY - A SELECTIVELY COATED, STEEL COLLECTOR WITH ONE TRANSPARENT COVER

Power Systems Division

Lewis Research Center

E-8641

INTRODUCTION

An area presently being investigated by the NASA Lewis Research Center in its efforts to aid in the utilization of alternate energy sources is the use of solar energy for the heating and cooling of buildings. An important part of this effort is the evaluation of solar collectors which have the potential to be efficient, economical, and reliable.

This preliminary data report gives basic test results of a collector whose performance was determined in the NASA-Lewis solar simulator. In the interest of providing performance data on this collector to the technical community as quickly as possible, the basic test results reported herein are presented without evaluation. Detailed analyses and interpretation of these results may be presented in subsequent papers or reports by this Center. Some of the results contained in this report may be changed as warranted by reviews and evaluations, or by obtaining additional data on this collector.

Reference 1 describes the solar-simulator test facility, as well as the basic test procedure.

COLLECTOR DESCRIPTION

The collector, made by Sunsource, Incorporated of Los Angeles, California, consists of a steel absorber panel (absorbing area = 15.96 ft^2) and seven parallel steel flow channels. The flow channels are spaced 3-5/8 inches apart. The absorber plate has a Tabor selective coating. The collector glazing material is one tempered, water-white crystal glass sheet that is 5/32 inch thick (area of the glass = 15.59 ft^2). An insulation of 3 inches of rock wool sewn in blankets is used to reduce conduction heat losses. A photograph of the collector on the test stand is shown in Figure 1.

COLLECTOR TEST RESULTS

Basic test results are given in Table I. Since this collector was larger than the area of radiation provided by the solar simulator, it was necessary to use a "shield" approach as explained in Reference 1. This technique allows one to determine the efficiency of the entire collector even though only a portion of it is actually exposed to radiation. By using the analytical method outlined in Reference 1 for a collector tested with a "shield", the results given for the two flow rates in Table I were used for a determination of the performance correlation given in Figure 2.

REFERENCES

1. Simon, F. F.: Flat-Plate Collector Performance Evaluation with a Solar Simulator as a Basis for Collector Selection and Performance Prediction, paper presented at the 1975 International Solar Energy Society Meeting, Los Angeles, California, July 28-August 1, 1975, NASA TM X-71793.

TABLE I - BASIC EXPERIMENTAL DATA

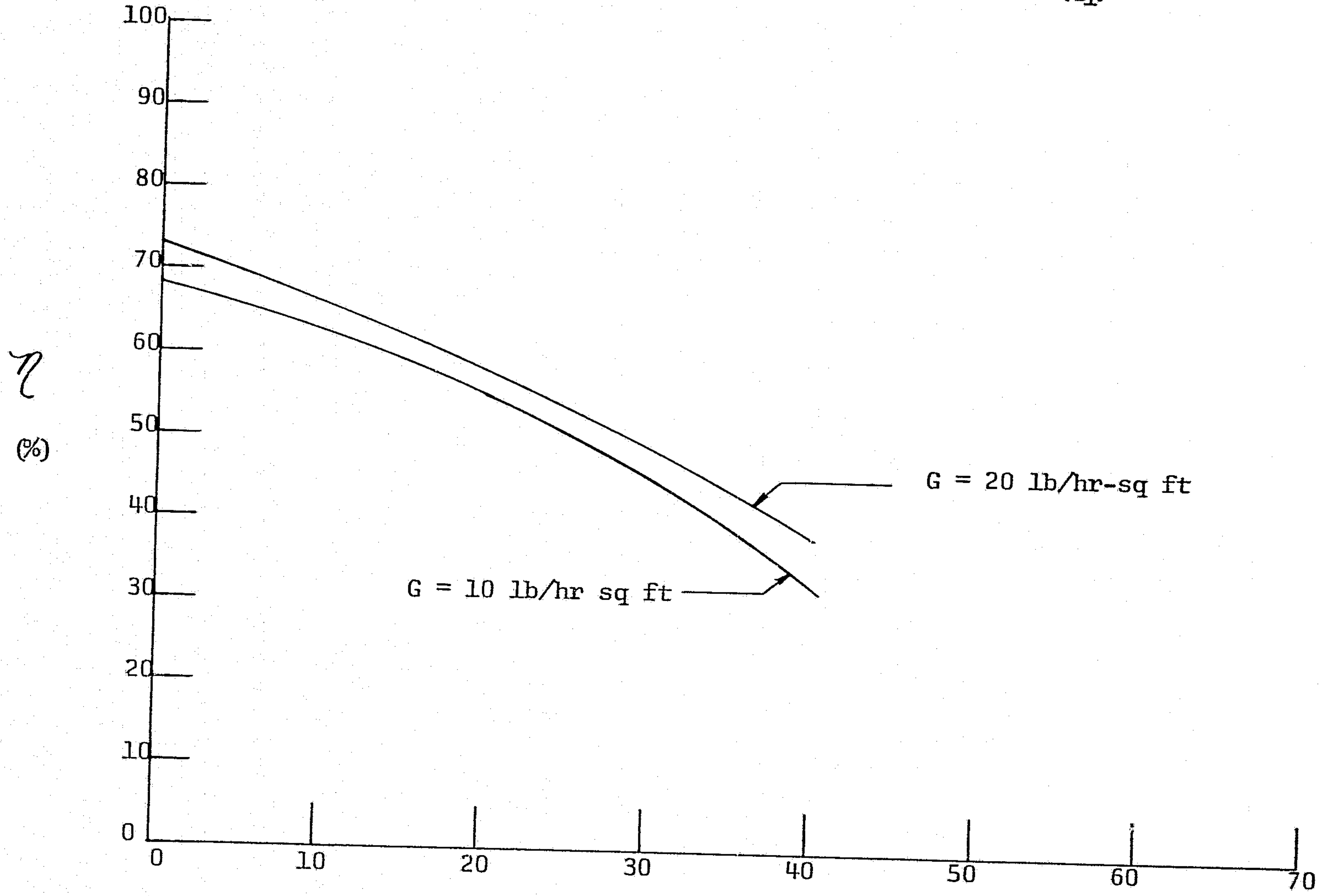
50/50 Water and Ethylene Glycol
Incident Angel = 0°
Tilt Angle = 57° Above Horizontal

Flow Per Radiated Surface Area lb/hr ft^2	Flow Gal/Min	Incident Radiation Flux Btu/hr ft^2	Fluid Outlet Temp., °F	Fluid Inlet Temp., °F	Ambient Temp.	Efficiency
14.323	0.29489	306.69	104.15	86.833	79.130	0.66602
14.320	0.29491	194.99	130.14	122.62	78.726	0.46356
14.320	0.29491	194.99	130.14	122.62	78.726	0.46356
14.397	0.29585	198.67	159.52	156.47	79.319	0.18881
14.397	0.29584	199.38	159.63	156.52	79.344	0.19158
29.224	0.59063	309.59	94.600	85.980	79.717	0.66816
29.207	0.59003	307.23	95.227	85.702	79.615	0.74362
28.830	0.59484	198.05	132.90	129.85	79.305	0.37488
28.829	0.59316	286.20	135.80	128.79	79.765	0.59439
28.921	0.59462	198.67	163.46	151.80	78.243	0.20676
28.920	0.59493	294.28	168.03	163.27	78.958	0.40224

E-8641

Figure 1. - Collector on Test Stand.

COLLECTOR EFFICIENCY (η) AS A FUNCTION OF AVERAGE FLUID TEMPERATURE (T_i) AND INCIDENT FLUX (q_i)



$$\frac{T_i - T_{ambient}}{q_i} \times 10^2 \left(\frac{BTU}{HR\ FT^2\ {}^\circ F}\right)^{-1}$$

Figure 2. - Collector Performance Correlation